

That the laws which regulate their effects on the muscles of voluntary and involuntary motion are different.

That both mechanical and chemical stimuli applied to any part of the nervous system tend to increase the action of the heart.

That neither mechanical nor chemical stimuli applied excite the muscles of voluntary motion, unless they are applied near the origin of the spinal marrow.

That mechanical stimuli have more effect than chemical on voluntary muscles, but the reverse with respect to those of involuntary motion.

That all stimuli continue to affect the heart long after they have failed to excite the muscles of voluntary motion.

That the motions thus excited in voluntary muscles are irregular, but those of the heart more regular.

That the former occur chiefly at the first moment of application, but those of the latter as long as the stimulus is applied.

That the former depend on intensity of the stimulus, the latter on the extent of surface to which it is applied.

That the power of the blood-vessels, like that of the heart, is independent of the nervous system, though they may be influenced through that system, as the heart is.

That the actions thus excited are regular, as those of the heart, and that their power, like that of the heart, may be destroyed through the nervous system.

On the Fire-damp of Coal Mines, and on Methods of lighting the Mines so as to prevent its Explosion. By Sir H. Davy, LL.D. F.R.S. V.P.R.I. Read November 9, 1815. [*Phil. Trans.* 1816, p. 1.]

The great sources of fire-damp in coal mines are blowers or fissures from which currents of this inflammable gas issue in considerable quantities and for a long series of years; but there is also a certain quantity produced by the workings. The author was informed by Mr. Hodgson, that if a cask be filled with a quantity of recently pounded coal, and a small aperture be made in it, inflammable gas will issue from the aperture.

In several specimens of fire-damp which the author has analysed, the inflammable part was the same in all; in some instances mixed with a small quantity of common air, in others with azote and carbonic acid. The purest contained only $\frac{1}{13}$ th of atmospheric air. One measure of this gas required nearly two measures of oxygen for its combustion, and formed nearly one measure of carbonic acid.

Sulphur heated in this gas decomposed it, forming sulphuretted hydrogen, and precipitating charcoal.

This gas, when mixed with chlorine, does not combine by exposure to light; so that it appears to contain neither olefiant gas nor hydrogen, and seems to be the same as the inflammable gas of marshes, or pure carburetted hydrogen.

When this gas is mixed with atmospheric air, it inflames by a lighted taper; but unless the quantities are duly proportioned, the inflammation is too slow to be accompanied with sound. The combustion appeared to be most sudden when there were about 7 or 8 parts of air to 1 of the gas. When 1 of the gas is mixed with 15 or 16 of air, the candle burns with an enlarged flame, which does not extend to the whole quantity, and the same phenomenon occurs when the gas constitutes no more than $\frac{1}{10}$ th part of the mixture.

The author next made trial of the degree of heat necessary for the combustion of this gas, which in fact is difficult to ignite, for even the electric spark will not explode a mixture containing 5 parts of air to 1 of the gas; but when the air is increased as far as 6 to 1, or nearer to the most explosive proportion, then it does take fire by the electric spark. Even the most explosive mixture will not take fire from well burned charcoal, nor by iron heated to any degree short of actual combustion. But on the contrary, hydrogen whether simple or sulphuretted, olefiant gas, or carbonic oxide, may each be set on fire very readily by all these means; and hence the gas procured by distillation from coal is liable to be fired by ignited iron or charcoal, in consequence of the olefiant gas which it contains along with the carburetted hydrogen in the first stage of the process of distillation, and on account of the carbonic oxide and hydrogen which it contains in the latter stages of its production.

Since the fire-damp of coal mines is free from these admixtures, it might be possible to light a mine by means of a charcoal fire, if free from flame, which is necessary for the ignition of the gas.

The method, however, which the author proposes, is not dependent on this property, but upon the supply of air to a lamp employed for that purpose being limited, in such a manner that the lamp will be extinguished by impurity of the air before an explosion can take place.

If a lighted lantern, in the bottom of which there is only a small aperture just sufficient for its supply, be inserted in a mixture of common air, with about $\frac{1}{10}$ th of fire-damp, the flame first appears feeble, next enlarges, and then is uniformly extinguished. In the lantern here proposed for coal mines, a chimney is added of such length as to prevent any communication from the enlarged flame upwards with the external air; and the opening below is designed to be at a fixed distance from the flame, by using oil lamps instead of candles. As an additional security in some cases, the author conceives it may be useful to add valves at the apertures, which may be made to shut by a thermometric spring when the heat is increased by enlargement of the flame.

Beside the foregoing, which the author terms the safe lantern, he has constructed two others on the same principle with that proposed by Dr. Clanny, and described in a late volume of our Transactions: but as that of Dr. Clanny has been found objectionable, not only on account of manual labour and constant attention necessary in working the bellows, but also on account of its size, those now proposed

are of smaller dimensions, one with a pair of small bellows, and the other with a syringe; but both of these, like the steel mill, require a person to work them constantly, and will probably be superseded by the simple construction first described.

An Account of an Invention for giving Light in explosive Mixtures of Fire-damp in Coal Mines, by consuming the Fire-damp. By Sir Humphry Davy, LL.D. F.R.S. V.P.R.I. Read January 11, 1816. [Phil. Trans. 1816, p. 23.]

This contrivance consists in covering the flame of any lamp or candle with a wire sieve, the apertures of which may be as large as $\frac{1}{8}$ th of an inch square.

When a cylinder of wire gauze, covered at top with the same gauze, is closely fitted to a lamp, and surrounds its flame so that there is no aperture but those of the gauze, if the little lantern so constructed be introduced into the most explosive mixtures of carburetted hydrogen and air, the cylinder becomes filled with a bright flame at its interior surface, which continues to burn as long as the mixture remains explosive.

When the carburetted hydrogen constitutes no more than $\frac{1}{12}$ th of the mixture, the flame of the wick continues to burn surrounded by the flame of the fire-damp; but when the proportion is as 1 to 7, the flame of the wick disappears.

When the apertures of the gauze are of the largest size, the flame is the most brilliant, and the wire of which it consists becomes ignited, but still without occasioning explosion of the mixture external to the lamp.

Similar experiments were also made with hydrogen (not carburetted), and with the same results. But in this case the gauze was of the finest kind, with 6400 apertures in the square inch; and since the thickness of the wire was $\frac{1}{32}$ th of an inch, the apertures themselves were about $\frac{1}{16}$ th of an inch square. With gauze of this construction a flame may be introduced even into a mixture of hydrogen and oxygen, and burn this mixture at the inner surface of the lantern, without communicating its flame to the mixture externally, even though the wires become intensely red hot.

After such trials of the security of this little apparatus, the author has no hesitation in recommending it for adoption by the collier, who will require for his security nothing more than a little wire cage to surround the flame of his lamp, and thus, at the cost of a few pence, will procure a light as long as there is a sufficient supply of fire-damp, without any further expense.